DOMINO

Microbes 4 Sustainable Foods
empowering tomorrow's food

Funded by the European Union

UK Research and Innovation

Design of Microbial Solutions (MS) for Sustainable and Healthy Fermented Food Perspectives & Challenges in Europe

Dr. Stéphane CHAILLOU (INRAE MICALIS institute, France)
on the behalf of the DOMINO & ANR METASIMFOOD project consortium.

HealthFerm Final Conference, Leuven, August 25th 2026.

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from objectives to impacts

WP4

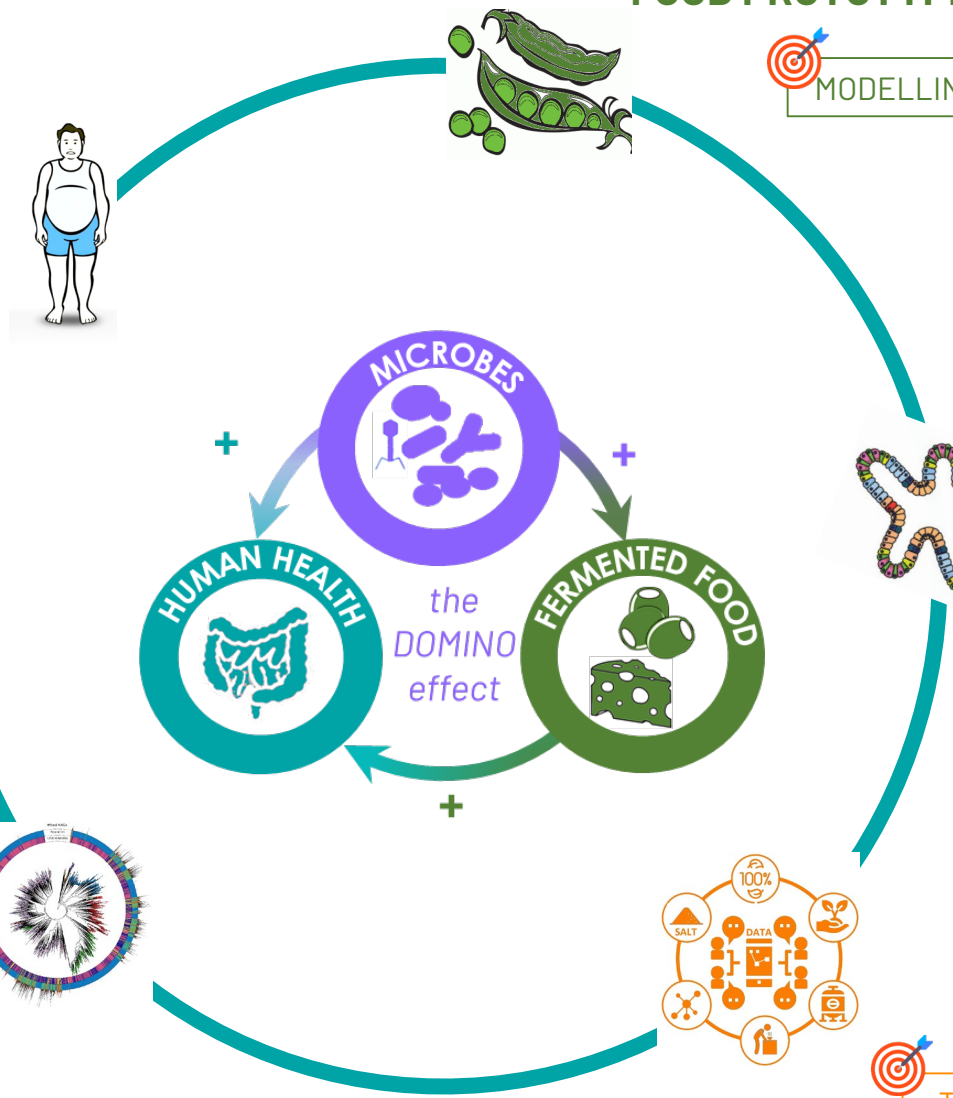
#3. DESIGN OF SIX HEALTHY PLANT-BASED FERMENTED FOOD PROTOTYPES FROM SUSTAINABLE SOURCES

MODELLING STRATEGY FOR MICROBIAL CONSORTIA DESIGN

WP2

#1. HEALTH ASSESSMENT OF FERMENTED FOOD-BASED DIET

FOCUS ON HEALTH BIOMARKERS LINKED TO FERMENTED FOOD



WP2 & WP4

#4. IMPLEMENTING HEALTH BENEFIT IN THE DESIGN

STANDARDIZED HEALTH BENEFIT/RISK ASSESSMENT PROTOCOLS OF FERMENTED FOOD

WP3

#2. THE OPEN FOOD MICROBIOME DATABASE (FMD)

FOOD-GUT MICROBIOME DATA & ANALYTICAL TOOLS

WP5

#5. LIVING LABS FOR MULTI-ACTOR ENGAGEMENTS

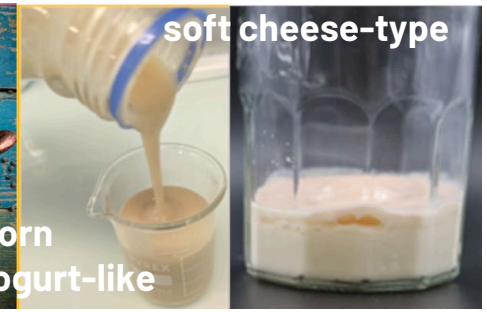
TO ENGAGE DIFFERENT STAKEHOLDERS TO EXCHANGE KNOWLEDGE & FIND SYNERGIES

From old to new & emerging type of fermented foods

New plant-based FF as alternatives

(no strong historical FF background)

- Production adapted to climate change
- Good nutritional value



Challenges

- Sensory attributes (off-odors)
- Vitamines deficiency (B9 - B12)
- Anti-nutritionals compounds
- Acceptance -> not-traditional.

From old to new & emerging type of fermented foods

Traditional plant-based FF with historical heritage

(spontaneous fermentations ~ uncontrolled)

- High diversity of microbial communities
- Associated with health benefits

Challenges

- New MS for new challenges
- Resilience of the new MS vs Spont.
- Proving that designed MS are better
- Acceptance -> not natural

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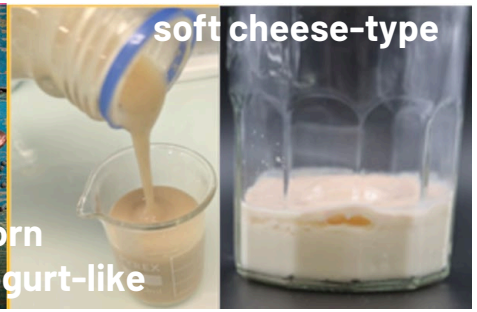

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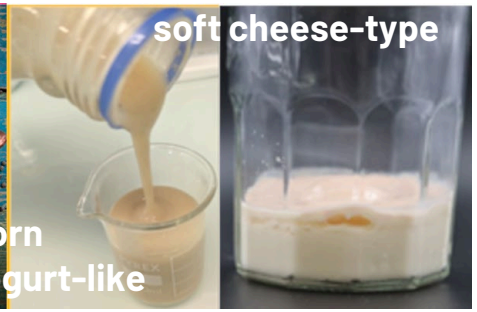

Challenges

- Sensory attributes (off-odors)
- Vitamines deficiency (B9 - B12)
- Anti-nutritionals compounds
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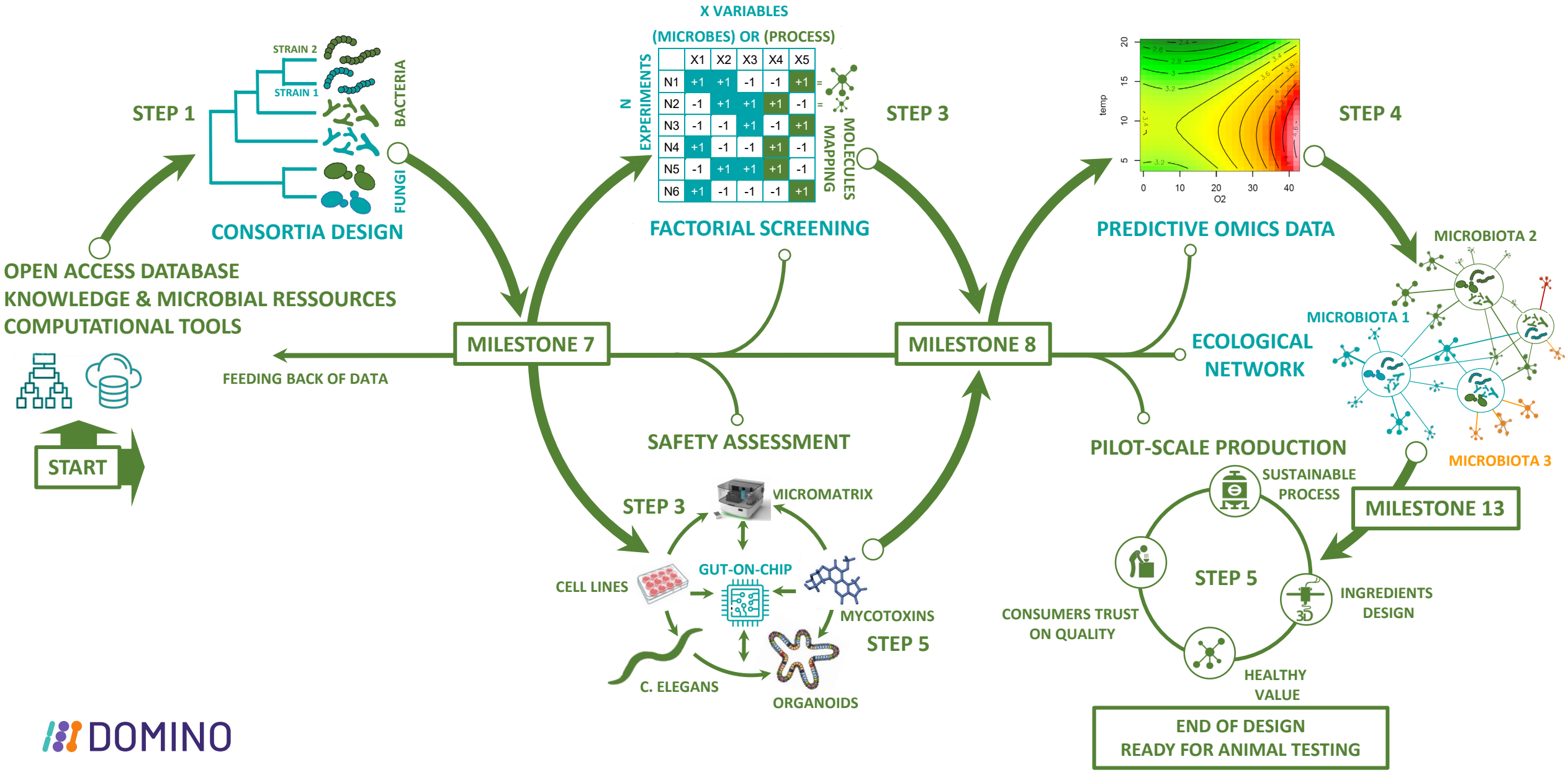
New plant-based FF or ingredients from food industry byproducts

(high health or sustainable added value is targeted)

Challenges

- Sensory attributes
- Challenges with health benefits demonstration – Acceptance at the whole food system

DOMINO workflow for synthetic ecology design



	X1	X2	X3	X4	X5
N1	+1	+1	-1	-1	+1
N2	-1	+1	+1	+1	-1
N3	-1	-1	+1	-1	+1
N4	+1	-1	-1	+1	-1
N5	-1	+1	+1	+1	-1
N6	+1	-1	-1	-1	+1

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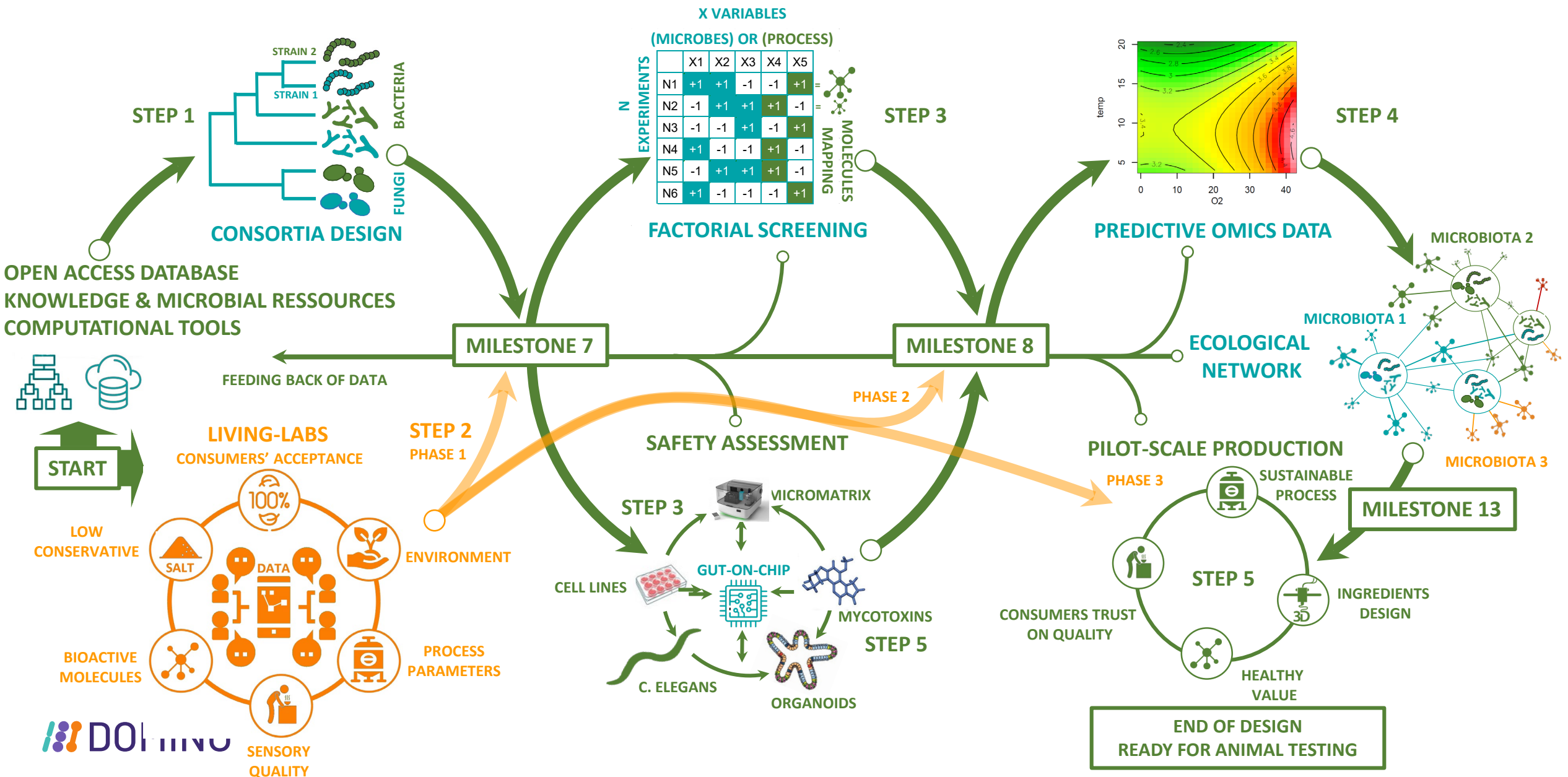
DOMINO workflow for synthetic ecology design

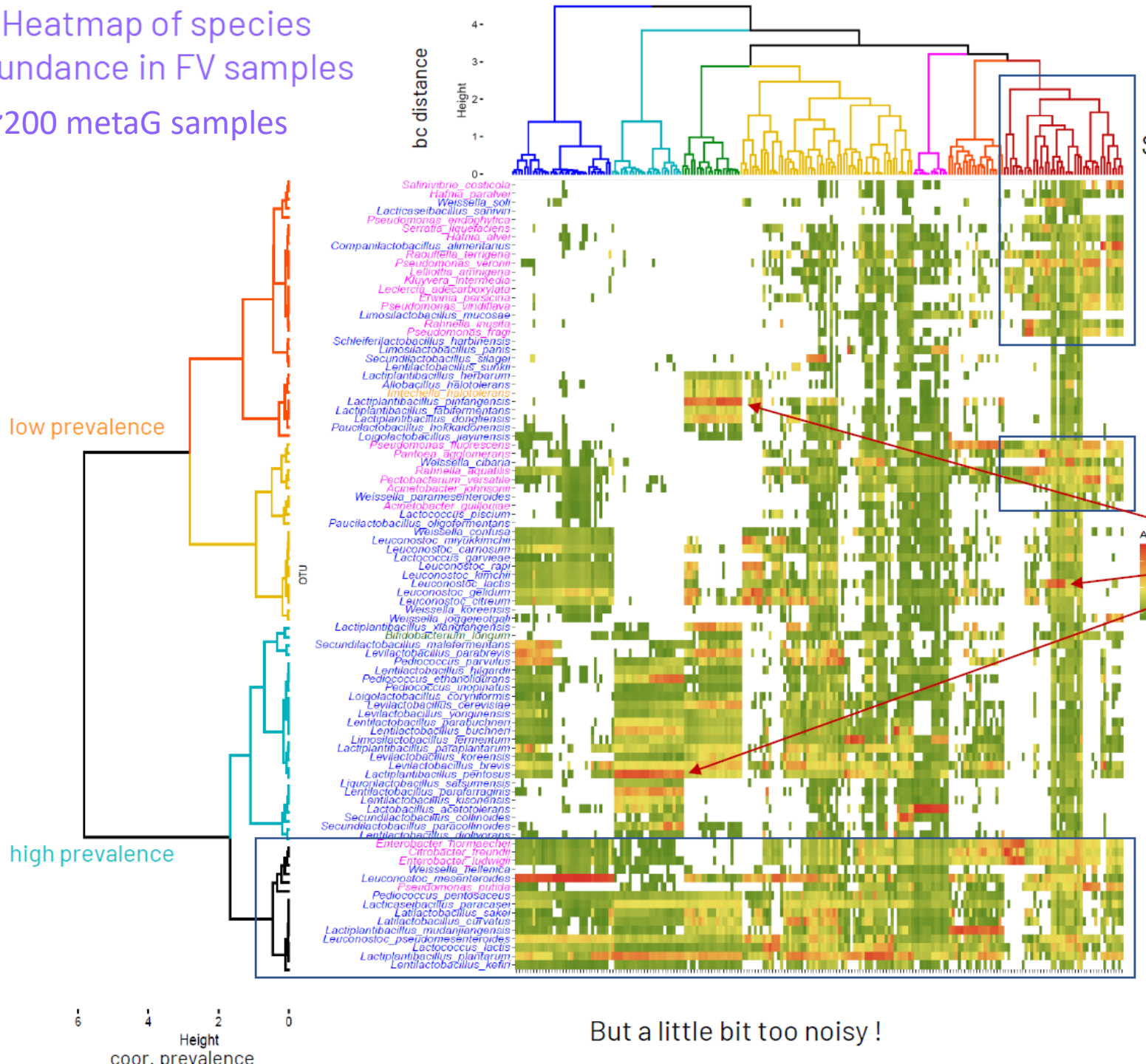


Fermented Vegetable case study in DOMINO

- Can we provide microbial solutions with improved fermentation properties (sensory – nutritional – healthy ?)
- Does the type of microbial community matters - and on what fermentation scenario ?
- Can we take into account the dynamic fermentation process in the design ?
- Would the MS be resilient to endogenous microbiota ?

Heatmap of species abundance in FV samples

~200 metaG samples



Samples with higher prevalence of *Pseudomonadota*

But a large diversity of abundant species across samples

Core group of species with high prevalence:

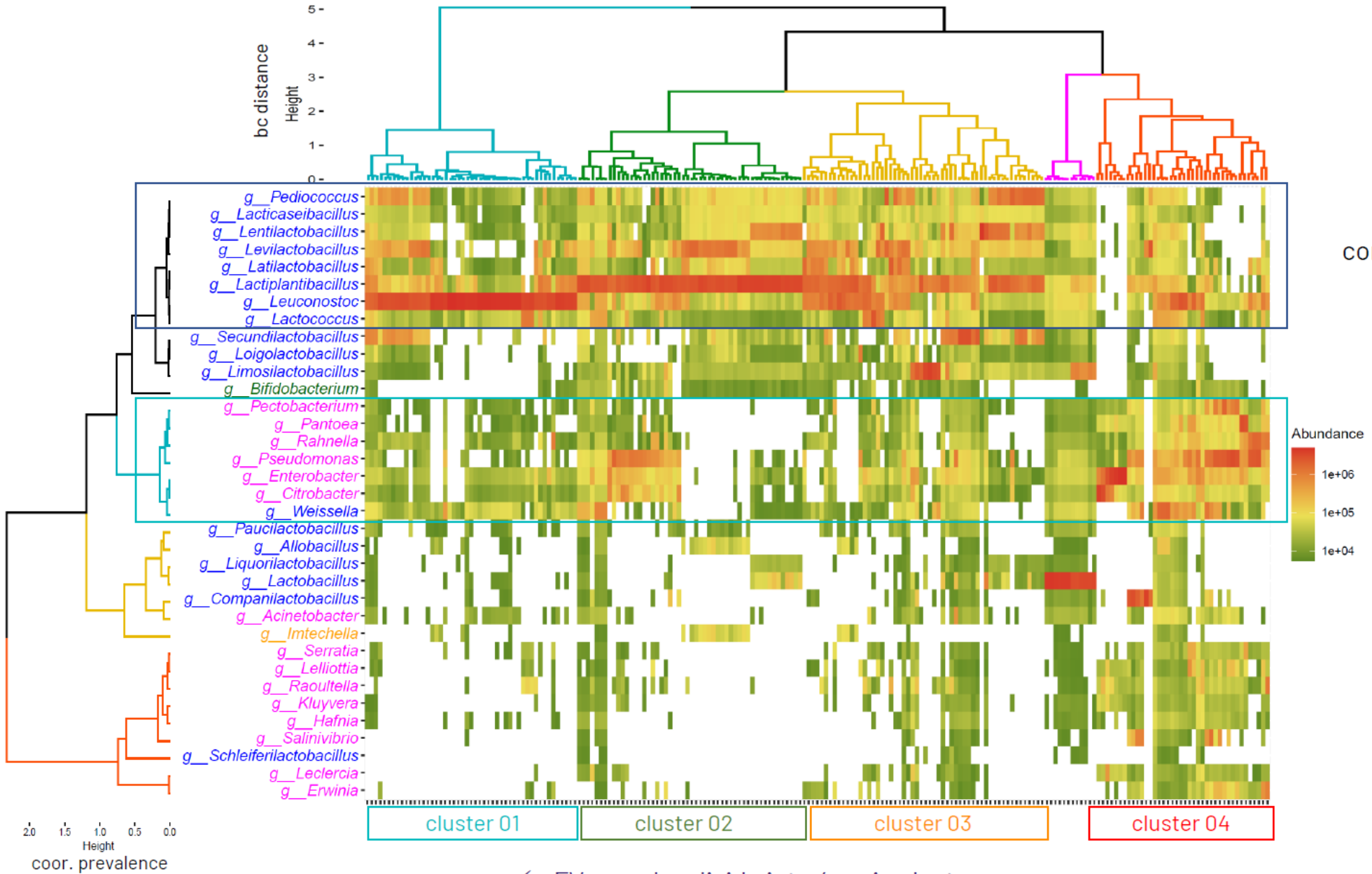
L. plantarum

L. mesenteroides

Most abundant !

But a little bit too noisy !

Heatmap of genus abundance in FV samples

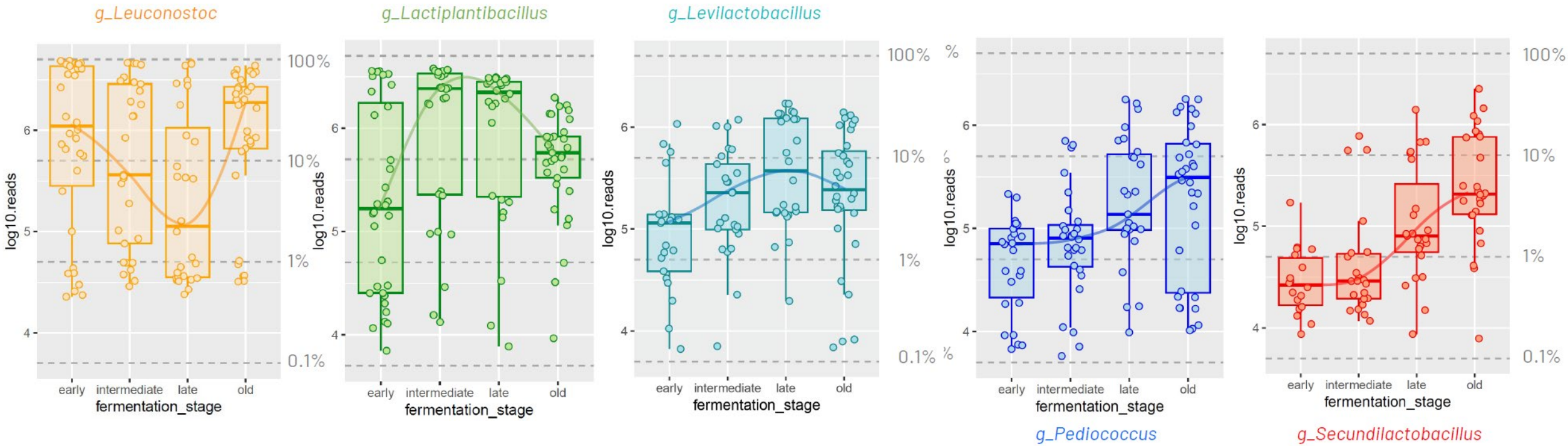


core group of genus with high prevalence

Group of prevalent *Pseudomonadota genus* + *Weissella*

✓ FV samples divide into 4 main clusters

Boxplot showing the relative abundance of core group genus taxa according to the fermentation stage



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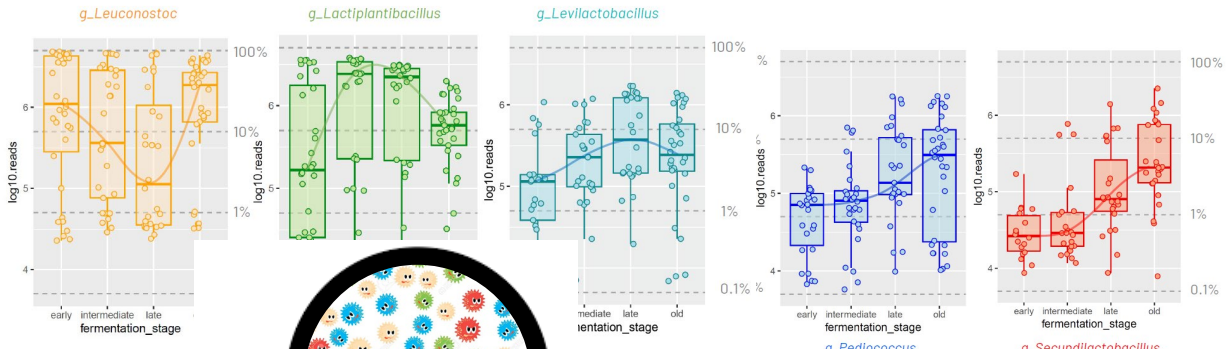
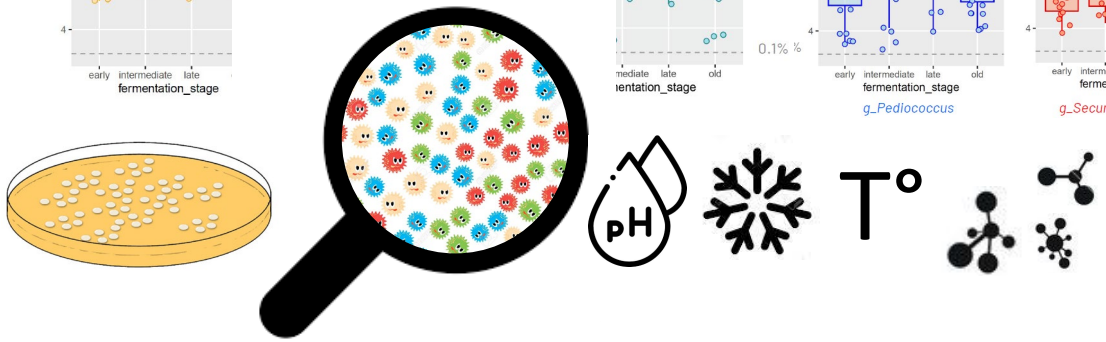
Strains selection:





362 strains

181 strains

- Sugars degradation profiles.
- Growth capacity at 15°C and 25°C versus optmial temp.
- Resistance score to acid stress (non-LAB strains)
- Stains associated metadata

61 strains

52 LAB
9 non-LAB

- Growth capacity on carrot juice, cabbage or turnnip-based agar medium

40 strains

Selection for test consortia

14 strains

Sequencing

40 strains

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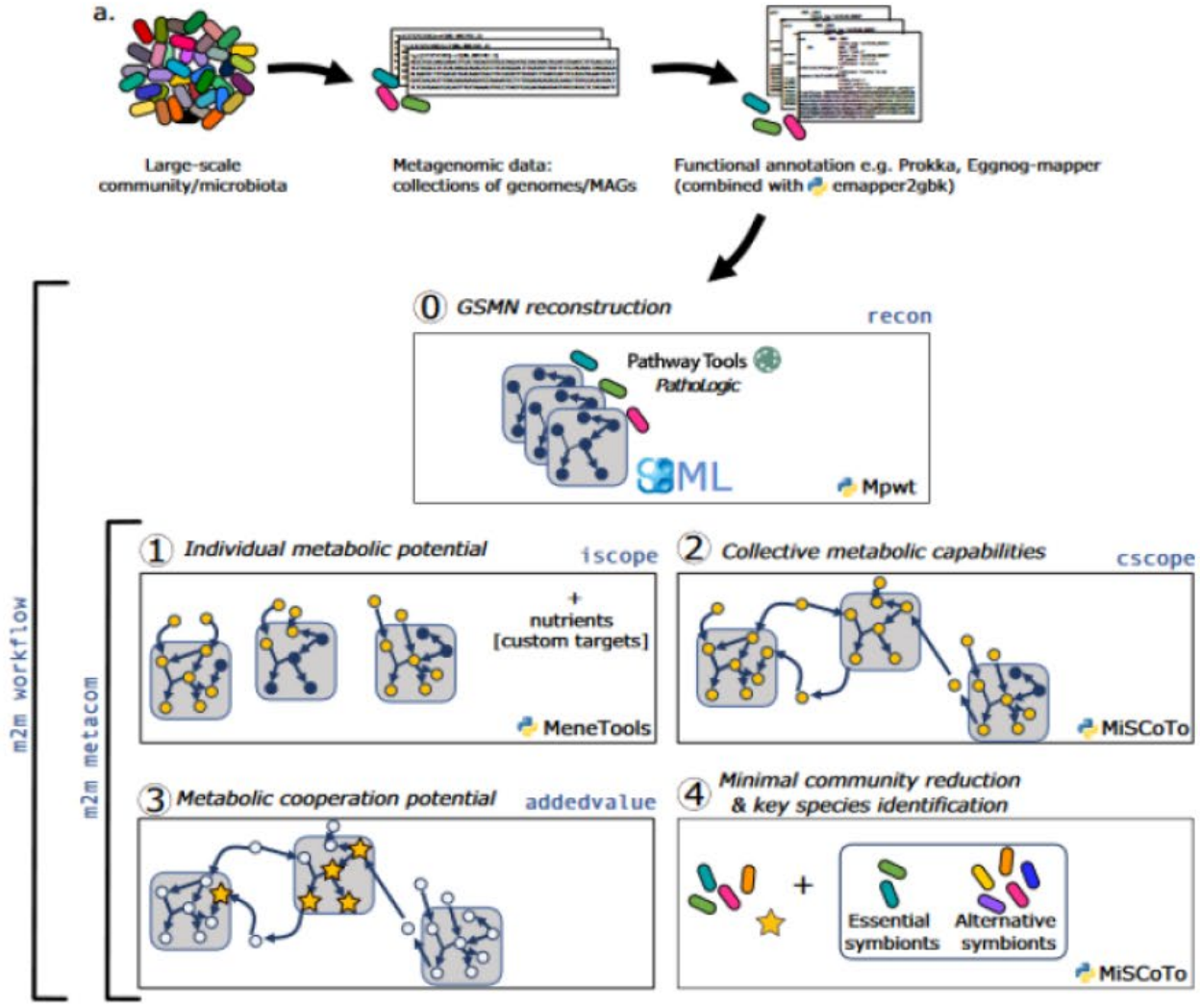
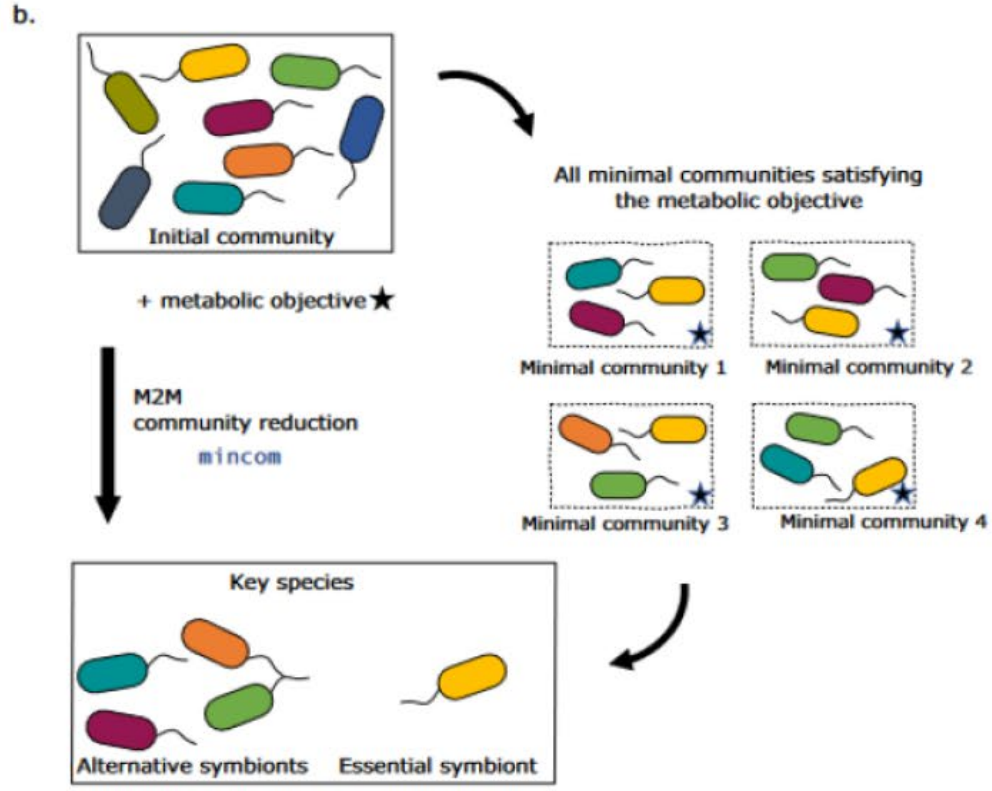
M2M modeling and design of MS





Belcour, Frioux, et al. eLife 2020;9:e61968.

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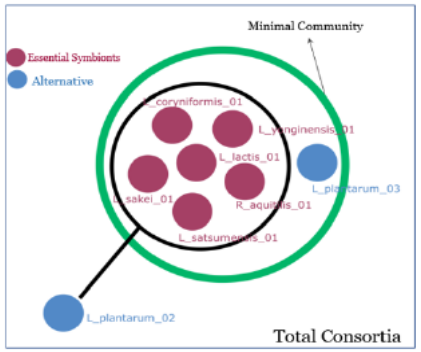
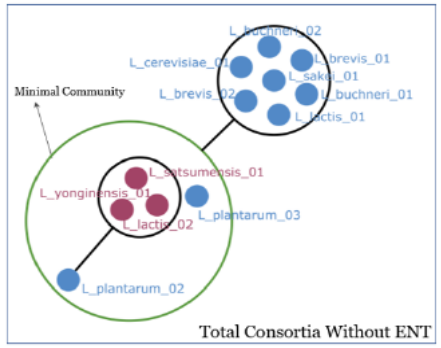
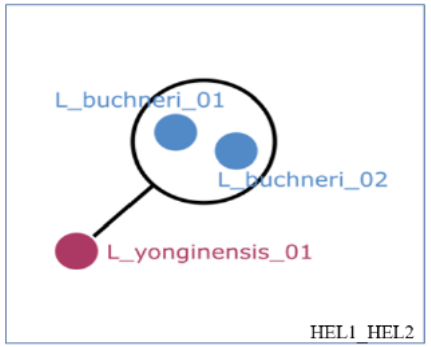
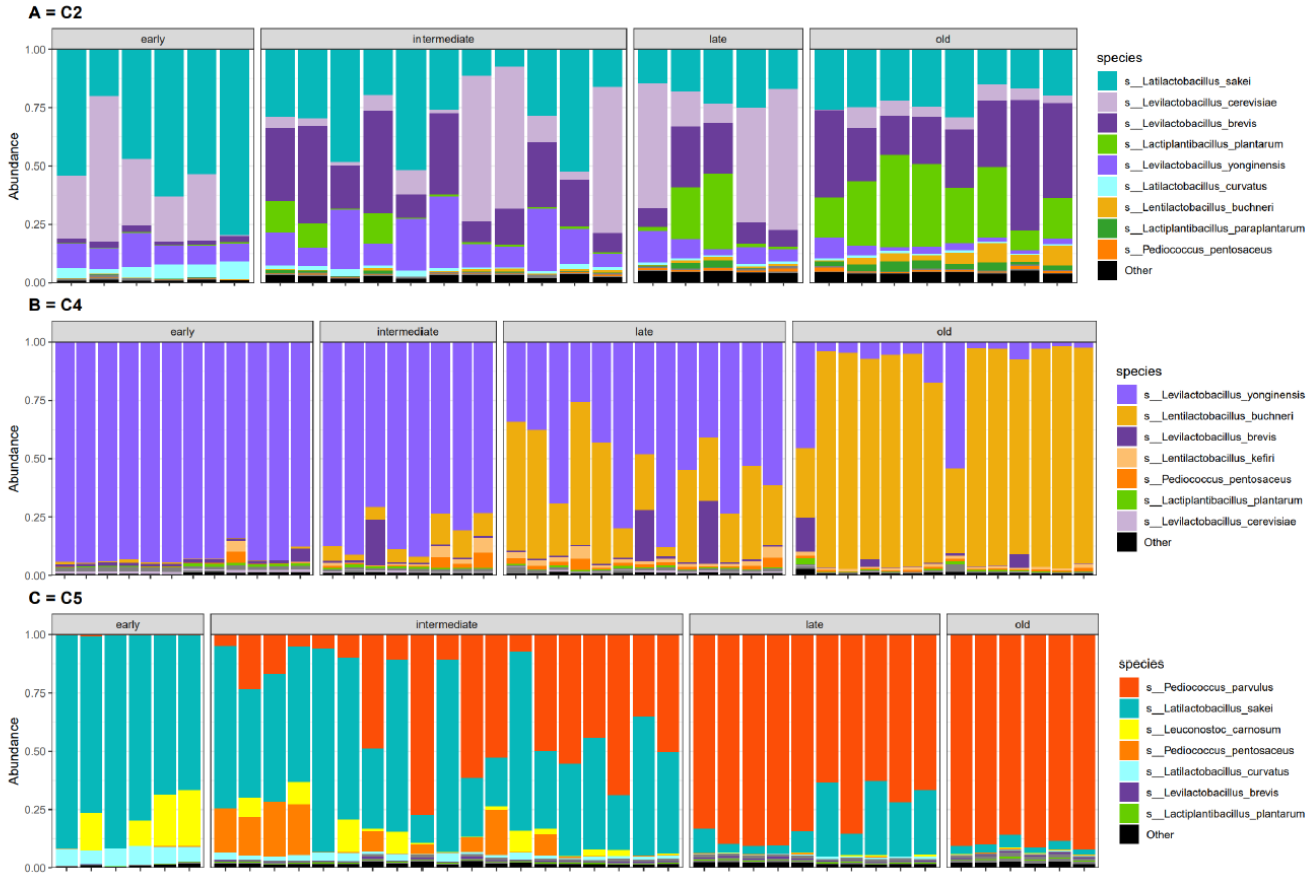
Testing the MS in lab-scale models







Consortium C2 Consortium C4 Consortium C5



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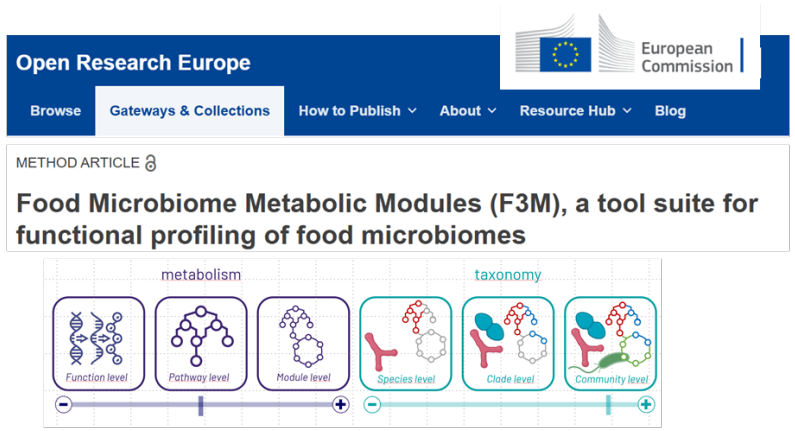
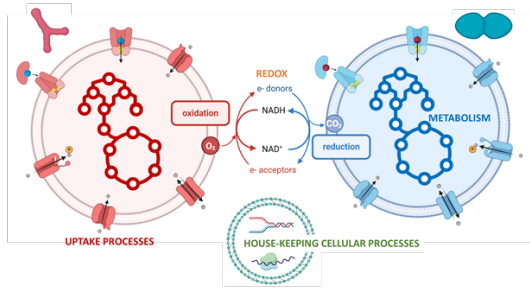
PcoA ordination of samples based on functional bc distance

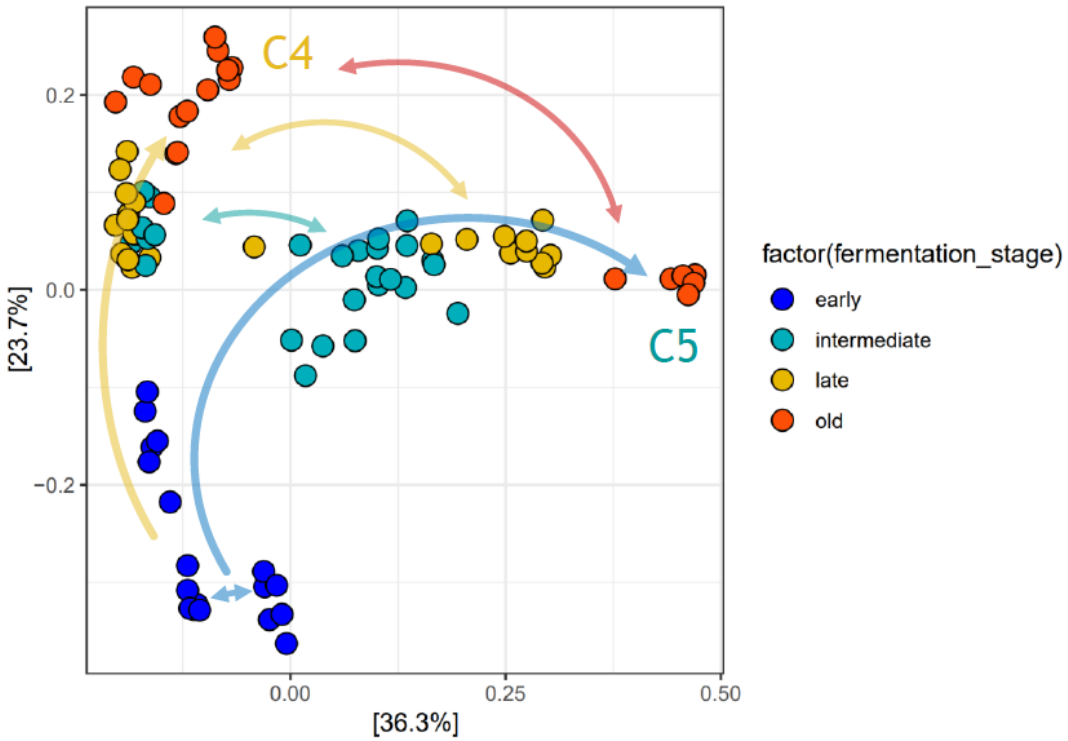
Food Microbiomes Metabolic Modules F3M

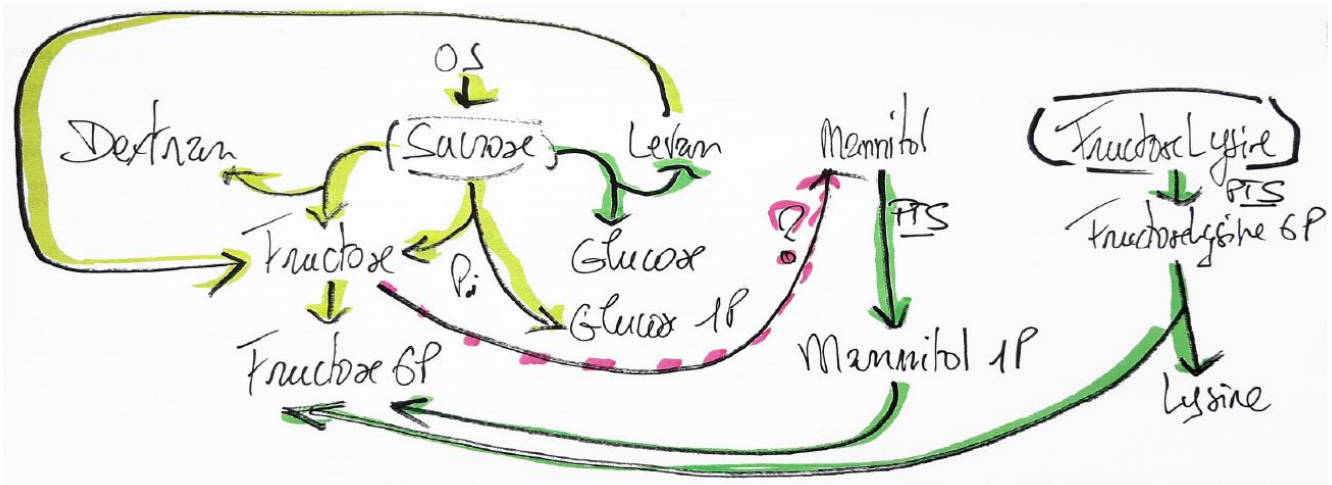


Tap et al. 2025 (DOI:10.12688/openreseurope.21502.1)



Clusters with only C4 and C5 consortia





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Conclusions on Fermented Vegetable MS design

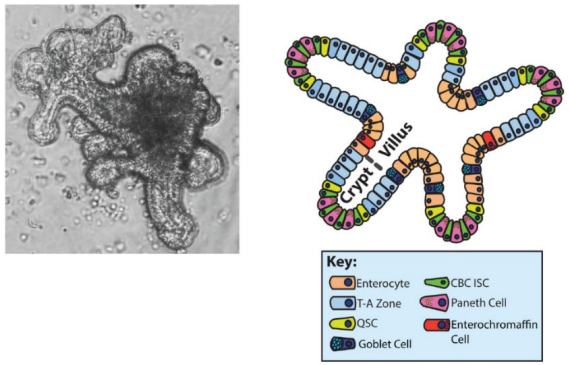
- The designed MS maintain the natural dynamic succession of species and its high metabolic diversity
- They performed better than most spontaneous fermentations (metabolic – sensory profiles)
- They are resilient at pilot scale – can be profiled to different temperatures of fermentations

NOW:

- Implementing the health benefit in the analysis of the MS.

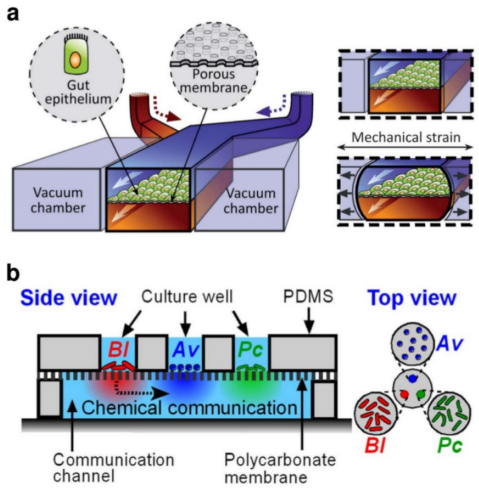
4. Implementing Health benefit in the design of consortia

- Human nutritional intervention are the 'golden rule' but long, tedious and expensive;
- It is very likely that long-term diet are necessary for establishing health benefit.
- Setting standard protocols for rapid estimation of health benefit using *in-vitro/ex-vivo* models



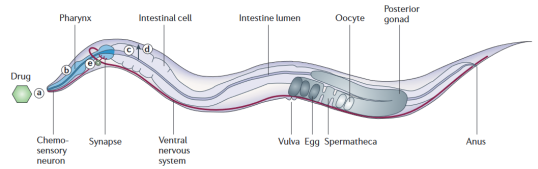
https://doi.org/10.1097/MPG.0000000000001411

2. Intestinal Organoids
absorption capacity of bioactive molecules



https://doi.org/10.1016/j.jcmgh.2017.12.010

3. Gut-on-Chip
Impact on microbiotas and food components on gut microbiome composition, immune cells response



https://doi.org/doi:10.1038/nrd2031

4. *Caenorhabditis elegans* model
Feeding behavior of the worm, Study of longevity/survival, host response and mechanistic studies (RNAseq/mutants)

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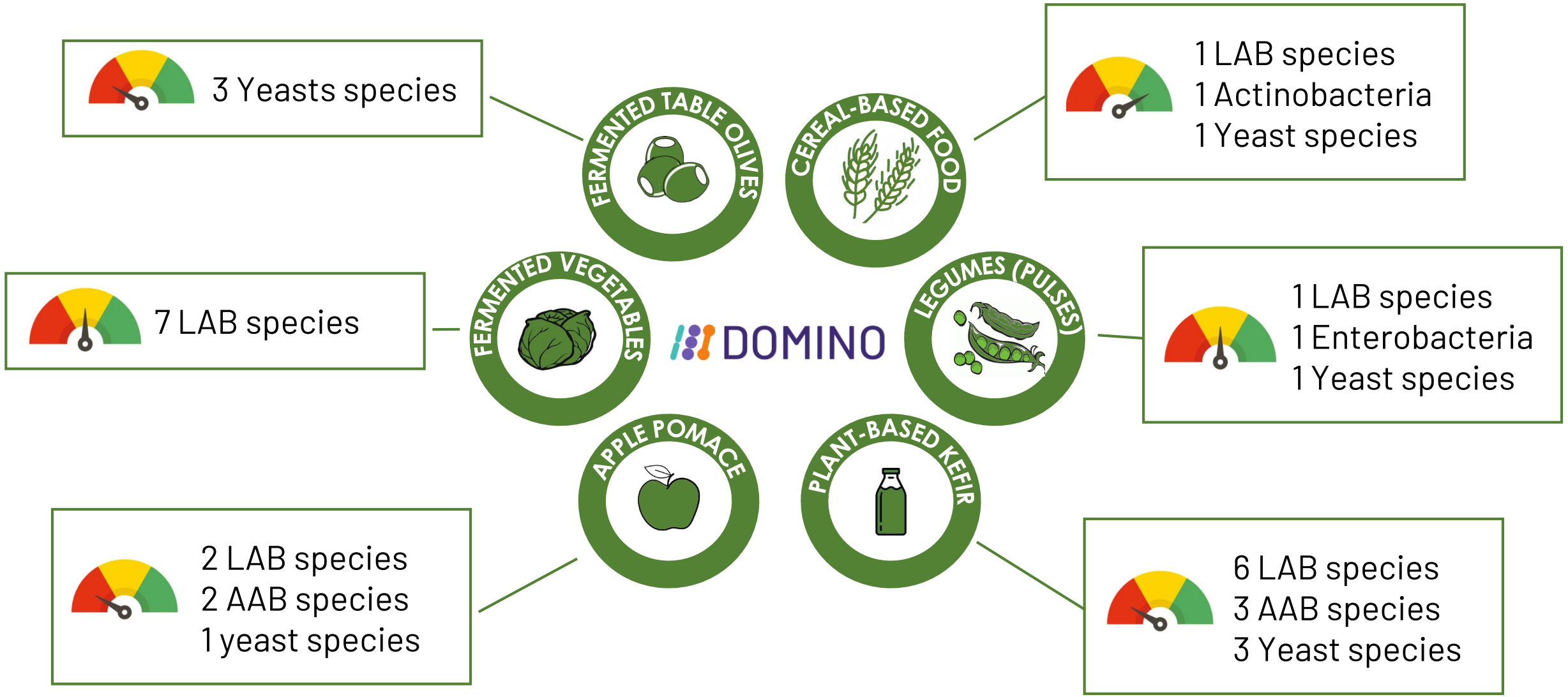
Summary of the MS in the 6 DOMINO FF prototypes



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Thank you !

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Food Microbial Ecology research group

https://fme.micalis.fr/

www.domino-euproject.eu

SciFoodHealth

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Sustainable Food Systems Network

Thanks to the DOMINO & METASIMFOOD FV Teams:

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